



The Sandbag House

High Living Comfort,
Economical and Ecological

by Stefan Kracht

*„Stones are primordial matter.
Sand is matter ground by the infinity of time.
It makes one mindful of eternity.
Sand is matter, which has been transformed
and has almost become liquid and spiritual.“*
(Unknown Author)

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2. Edition 2009
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Supported by:
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Patents:
The Ecobeam and the Building-by-bag System are patented.
Owner of the patents is Ecobeam Technologies, South Africa.

Disclaimer:
This document is not an instruction manual. For construction guidance professional assistance is required. We take no responsibility for possible mistakes or structural damage due to following this guide.

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1. Introduction

At the beginning of the 21st century, the building industry is marked by the development of more and more highly technological and specialized new building materials. Trying to solve the world's environmental and energy problems by producing expensive artificial materials in centralized high-tech factories seems to be the current trend. Simultaneously, the on-site building process is becoming more and more complex and difficult and requires highly skilled and very expensive labour.

Contrary to this, a revolutionary simple and easy building system was invented in South Africa: building houses with sandbags. While providing a high-quality home for the customer, the system is enormously ecologically friendly and economical at the same time. The combination of these two qualities inspired the names Ecobag and Ecobeam for the patented technologies of building by bags and making a very inexpensive beam structure. In all aspects, like stability and thermal behavior, the sandbag wall is superior to a conventional brick wall of the same thickness.

The sandbags in combination with a light Ecobeam structure can be seen as a modified timber-frame house. But once the roof is in place and the building is plastered, the whole structure behaves monolithic and appears exactly like a common brick house. The system is not dependent on any kind of industrial grid measurements. That means that any specific measurements that are required for wall thickness, size and height of the building or for wall openings, can easily be achieved. This is just one of many more advantages that makes this new building technology perfectly suited for building projects around the world.

1.1 History of Sandbag Houses

Using sandbags piled up to create a wall is nothing new. For decades or even centuries people have been aware of the good qualities of sandbags for flood protection, for sound insulation or in providing shelter against bullets. But the idea of using sandbags as a construction material for ordinary housing is fairly new. It was developed as a complete building system during the last ten years in Cape Town, when Michael Tremeer and his company Ecobeam Technologies searched for a cheap way to assist South Africa in its endeavour to house millions of homeless residents. The result was the simple idea of building the walls of houses out of sandbags.

The roots go back to the early 1970s when the innovative Michael Tremeer served as a civil engineer in the Rhodesian army. Adding a layer of sandbags to the poor sheet metal shacks was an easy job but had a tremendous impact on the living comfort. In the late 1990s, after the breakdown of the Apartheid system in South Africa, millions of people went to the cities and started to live in squatter camps in squalid conditions. Feeling a need to help, Tremeer invented the Ecobag system to provide an absolute low-cost building system. Now housing was available for only two-thirds of the cost of a conventional brick house.

But the idea was too simple. Due to political pressure and the influence of the cement and brick industries, the system could not prevail in public housing projects. Ecobeam Technologies kept on developing the system, extensive lab testing was done and general building approval for the Ecobag system was attained in South Africa. Contrary to the original intention, more and more wealthy people wanted to build ecological buildings by using sandbags. Over the last ten years, about 200 houses were realized all over the southern African countries.

With the change of consciousness to more environmental concerns in the building sector all over the world, 2008 started to bring a big boom to the sandbag system accompanied by broad media coverage with articles in the most important South African magazines. Ecobeam Technologies is expanding. The first bigger projects of privately sponsored public housing in South Africa and Namibia with hundreds of Ecobag houses have been launched. And a worldwide spread of this technology started. The first demonstration projects are in realization in Ukraine, Mexico, India and Spain.

2. Why build with Sandbags?

To say it in one sentence:

Because with sandbags you can build better quality houses for less money by using absolutely ecologically sound and natural materials.

2.1 Ecological Reasons

In contrary to most other building materials, there is no need to process the sand. There is no energy consumption for burning bricks or producing cement. The energy required for making the polypropylene bags can be neglected as the bags are very thin and contain the smallest amount of materials. The same is true for the metal used in the Ecobeams. So the impact on environmental influence is tremendous: the carbon dioxide emission of one square meter sandbag wall drops by more than 95% compared to a conventional brick wall. If you use a natural material like hemp for the bags instead of a geo-textile it can be reduced even more. The metal lattice, at least of the non-structural wall beams, can be exchanged very successfully for a recycled polypropylene material.

Sand can be found locally nearly everywhere around the world, in some regions even directly on the construction site. As there is no need for centralized processing, there is very little transportation of materials. The sand makes up 98% of the weight of the wall materials.

An earthen plaster is the ingredient to make the building completely green. The clay sticks perfectly to the open porous structure of the bags and no wire mesh is necessary to reinforce the earthen plaster.

2.2 Economic Impact

It is impossible to say generally how many percent you save compared to a conventional house. Too many different factors influence the impact of the sandbag system, like climate, standard of interior work and labour costs. In South Africa the absolute low-cost housing can save more than 40% by applying all Ecobag features whereas the savings in the US or in Europe are estimated to be only about 5%. However, you will have a better quality and more ecological house for the same price as for a conventional one. Or if you do not compare it with a conventional house but with an all-natural house (e.g. rammed earth), then it is definitely cheaper with sandbags. If time is money, then the Ecobag system has the advantage of a very rapid construction rate. And it also provides a monolithic high-weight construction without bringing moisture into the building. If you use cladding or siding instead of plaster you can finish the house ready for use within days.



2.3 Superior Material Qualities

The Ecobag System exhibits tremendous thermal stability. The occupants will be kept cool in summer and warm in winter, due to a high thermal mass. Millions of small air spaces between the grains of sand are responsible for comparatively good thermal insulation.

It also has excellent sound-absorbing properties which help to provide a measure of privacy in close-quarter living or within the house between different units. Another feature that guarantees a high living comfort and a healthy room climate are the „breathable“ walls. Sand, the geotextile of the bags and the earthen plaster are vapor permeable.

Due to the enormous weight of sand these houses are very wind resistant. And the unique quality of sand to absorb impacts is not only responsible for making the walls absolutely bullet-proof, but in the same way the walls seem to absorb the power of earthquakes very well. Tests

according to the California Standards have documented the Ecobag system as one of the best constructions for earthquake regions. And of course, plastered sandbag walls are fire resistant. These characteristics are documented by various lab testings mostly done in South Africa. And practical experience of people living in sandbag houses is echoing these great qualities.

2.4 Simplicity of Construction

The construction technique can be learnt easily within a few days by people without experience in the building trade. A regular „builder“ would pick it up immediately. The relatively small sandbags weight only 7 kg and the Ecobeams are also very light in weight and can be handled easily by one person in all phases of the construction. All members of the community can be involved, thereby creating a sense of ownership, belonging and contribution in the participants. For construction sites in rural areas it is good to know that construction of Ecobag houses can take place even at locations without road access. This reduces the damage and congestion caused by heavy trucks which carry bricks and cement. 1500 bags fit into the boot of a small car and weigh only a few kilograms. This is the equivalent of 3000 bricks over the same area in a cavity wall. No bricks are scattered about the site before, during or after completion, thus eliminating „site-clearing“, which is a major cost factor on any building site. Unused bags can be removed from the site overnight thereby reducing the incidence of theft. Also no electricity is required at the construction site and only minimal amounts of water and cement are necessary.

3. Components

3.1 Ecobeam

The Ecobag system is formally presented as a modified timber-frame house. The frame of the house is constructed with Ecobeams forming the inside and outside walls as well as ceiling and roof. The uprights in the wall are spaced approximately 900 mm apart. Any type of window or door can be mounted on the frame. The best way to realize low-cost housing is to put up this light framework by a professional company first. It functions like a three-dimensional plan making it quite easy to the future inhabitant to finish the in-fill of sandbags by himself without being skilled in construction work.

The Ecobeam is designed to reduce the use of material for the necessary framework structure of the house to an absolute minimum. It is constructed using two timber sections, which are joined together by a lattice made of a single galvanized steel strip (hoop iron). Being fed through a press using a specially designed „die“ shapes the strip. The shape of the strip enables it to be nailed (either by hand or by nail gun) in a zigzag fashion between the two timber sections. This is done on a special workbench that holds the timber absolutely straight and parallel. The table has an adjustable component which makes it possible to construct a beam of any required width. The beam sections are easily joined to any required length.

The Ecobeams used for the wall frames are considered as non-structural. This means that any kind of cheap or bent wood can be used. Once the formed metal strip is nailed into position between the header and footer timber components, the Ecobeam is formed and will remain stable with perfectly parallel sides. Long spanning Ecobeams are light and easily fabricated, doing away

with the need for heavy laminated wooden or metal beams. Should curved or prestressed beams be required, these can be easily formed using Ecobeam technology. Traditional stud walls are limited to the width of the stud being used. No such limitations affect the Ecobeam system. Wider beams can be produced without any extra costs.

The beams are somewhat smaller than the total wall. This way it is very easy to fix a wire mesh to reinforce a cement plaster or to apply a wooden cladding. But if the wall should be plastered with clay and wood is cheap, then it is certainly possible to use a traditional timber frame construction instead of the Ecobeam.

3.2 Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. As the term is used by geologists, sand particles range from 0.0625 (or 1/16 mm) to 2 millimeters in diameter. The most common constituent of sand, in inland continental settings and non-tropical coastal settings, is silica (silicon dioxide, or SiO₂), usually in the form of quartz. Sand can be found in places all over the world and is considered to be an unlimited resource.

From the viewpoint of a scientist, sand is a really interesting material as it contains fluid as well as solid characteristics, but has additional its completely unique characteristics due to the grain structure of sand. For example the ability to absorb and resolve all kinds of impacts. Within seconds, forces are distributed to countless sand grains and in this way just disappear. This might be the explanation for the fabulous earthquake resistance of sandbag houses and also for the excellent sound-insulating properties.

Another interesting characteristic is the comparative low density of sand. Clean sand has usually 40-50% voids. That are billions of small air spaces, which are responsible for the relatively good thermal insulation of sand. It is still controversial how good the insulation really is. The values for dry sand that can be found in literature are not very precise and vary in a large range with Lambda-values around 0.4 W/mK (US 0.5 R/inch). Which means that the insulation of a 30 cm thick sandbag wall is at least double as good as the insulation of the standard 24 cm brick wall that is most common in all warmer countries including southern Europe, India and China.

In cases where the insulation value is not important it is also possible to use different other infills for the bags like pit sand, gold mine residue or crushed stone.

3.3 Bag

A good adhesion and durability are the most important qualities for the choice of bag material. A thin non-woven geo-textile made from polypropylene or polyester is commonly used for sandbags. Its structure is like felt and guarantees a good adhesion, which is of double importance. First, the bags do not slip off from each other, they stick safely together in the wall. And secondly, it guarantees a good adhesion of the plaster to the bags. The plaster penetrates the bag and can never fall off. An earthen plaster can be applied without a wire mesh reinforcement. Another good feature of the geo-textile is that it is vapor permeable due to the millions of small holes between the fibres.

Of course it is desirable to use a natural material. Jute, hemp and cotton have all the same positive characteristics as mentioned above, except the durability. Jute and cotton will start

to rot as soon as the somewhat wet sand is filled in the bags. Hemp is much more moisture-resistant than the others. It might perform well considered that in the long term we have a dry wall, after the moisture of the construction process is out of sand and plaster. The reason why hemp has not yet been tried is that it is comparatively expensive.

Geo-textile is produced in factories all over the world. It can easily be bought on big rolls and then locally manufactured to the right size bags. If cheap labour is available this can be done with a normal sewing-machine by hand, or with a small welding machine. Once the sand is filled in the bags, it is very easy to close them, just by flapping over a pillow-slip-type close.

3.4 Wall Finish

The finish of the walls is a matter of choice. The most common way is to plaster the walls. It represents the monolith and solid character that the building is made of. Sandbag walls can be plastered perfectly straight as any other building type. Nearly all houses built in South Africa are finished with a classical cement plaster. To make the house most ecological and healthy, clay and/or lime plaster are a perfect choice. Earthen plaster requires no processing energy, is vapor permeable and responsible for a very comfortable room climate. And if labour is cheap, then it is also the least expensive way to finish the wall. Care should be taken to protect the clay from rain erosion. This can be done by large roof overhangs, breathable paints like lime wash or by applying a thin finish layer of lime plaster.

The exposed Ecobeams also enable a sheeted or planked timber finish on the inside and/or outside of the wall. Once the frame is up and boards on the interior are affixed, the services are easily installed prior to the bags being laid. The interior boarding also provides a built in-guideline to achieve a straight laying of bags.



3.5 Foundation and Floor

Cost saving and ecological benefit are starting with a simple form of foundation that can be used for sandbag houses. Usually very deep and strong concrete foundations with steel reinforcement are done for new houses around the world. This is due to the fact that brick houses can get dangerous structural cracks from the smallest ground movements. But these movements

do not affect the stability of sandbag houses. Of course the organic top soil has to be removed and the soil underneath has to be checked if it is stable enough. If this is the case, then some double layers of bags filled with sand stabilized by cement can form a very simple foundation. If the topsoil goes deeper down, then a rock bed of gravel can be a good alternative to concrete. The sandbags can be laid directly on the gravel. To leave out the concrete and steel makes a big impact on reducing CO₂ emission and will also be cheaper.

The same principle as for the foundation can be applied for the floor. Only one layer of sand stabilized with cement is the flexible basis for a thin layer of unreinforced screed. This floor performs very well and is long-lasting in many sandbag houses in South Africa. To avoid the cement completely, earthen floors or wooden floors are good alternatives.

3.6 Ecological Add-Ons

You can see the sandbag system as an enabling technology to reach the goal of an all-natural house. This goal is not only important for a sustainable approach to nature, but also for the occupant himself. The first step to reach this goal is to make the structure and the walls out of natural and healthy materials and to have a certain degree of thermal mass and insulation. The second step is to control the energy that is required to run the building. We found that there are some really easy and inexpensive solutions to save energy, use sustainable energy and reduce pollution.

On a sandbag demonstration project in Chihuahua, Mexico most of these ideas were realized: The heating system for the cool but sunny winter months is a solar-air-heating system. Air is heated up in a solar collector on the south wall which then heats up a rock-bed under the floor or in an inside wall. The rock-bed stores the heat and radiates it constantly throughout the night.

Hot water is provided by a common solar water heater. Electricity in the whole house runs on a low voltage system with LED-lighting. This reduces the demand of electricity dramatically. The power can be produced by a photovoltaic solar panel, a rechargeable battery is providing electricity at night. Computers or other high-voltage items can be run by using a converter.

An additional feature would be to deal with the waste water in a natural way. There are different solutions. The most effective way is leading the sewage into a bio-digester in order to produce bio-gas for cooking. Another method is to clean the waste water in a reed bed. Afterwards it can be used for irrigation in agriculture. It is important to transform and use the sewage locally.

How it works

The following is a detailed description of how to build the standard Ecobag house as it is normally done in South Africa. It should give a rough idea of how the technique works.

4.1 Materials Needed

- Lattice for standard wall Ecobeam: Galvanized Steel, 38 mm wide, 0.6 mm thick, endless from a roll.

- Timber for standard Ecobeam: 38 x 38 mm battens (Ceiling and roofs require larger dimensions of lattice and timber).
- Joints: 40 mm rifled nails or screws, 80 mm nails, 1.5 mm metal wire.
- A small amount of cement for the foundations.
- Sandbags: Polypropylene or Polyester geo-textile or if natural material, then rot-resistant like hemp, or perhaps jute. Size according to wall thickness.
- Sand: Any kind of sand can be used. It should not contain any clay or top soil. Dune sand is considered to be the best insulator.
- Damp-proof course (DPC): Avoid using a bitumen-based material.
- Plaster: normal cement plaster is commonly used, but more ecologically-friendly kinds of plaster like lime or clay plaster are preferable.
- Insulation material for the roof: If possible use a locally available natural insulator.
- Special tools: Fly press and special dies to press the lattice in shape. Right-angled workbench to produce the Ecobeams. Measure to fill the sand bags. Different kinds of tampers to compact the sandbags.

4.2 Production of Ecobeams

- Construct a workbench with a mould of the exact width of the type of Ecobeam you want to produce. One end should be closed in a right angle, the other one should remain open.
- Start making the beams by putting the first two pieces of timber into the mould. Make sure the timber is pushed against the closed end and lying tightly next to the sides of the mould; if necessary fix them temporarily to the mould with C-clamps.
- Bend the lattice into a zigzag and fix it with nails to the timber, start at the closed end of the mould.
- While fixing the lattice at all bending points, make sure the lattice is always pressed against the timber pieces and towards the closed end of the mould. This way you get a strong beam.
- If you have to connect two pieces of lattice, overlap them and fix with the same nail. Finish the beam by cutting the lattice with tinner's snips behind the last point where you can fix it to the timber.
- Mark all finished beams and pack them in bundles for each wall.



4.3 Site Preparation

- Clear site of all loose debris and vegetation.
- Fix the rough position of the house.
- Level an area that is on every side approximately one meter wider than the house's outside measurements on the plan, ensuring that any rainwater can drain away from the site.

- Put in an underground sewage pipe and empty pipes (channels) for water, gas, electricity, etc
- Install a profile board in all corners of the house, on which you mark the exact positions for excavation/foundation, plinth, wall studs and finished outside wall, taking right angles into account.



4.4 Foundations

- Excavate for foundations to a depth of 100 mm and a width of 550 mm according to the measurements in the foundation plan.
- Mix building sand with cement in the relation 10:1 (earth wet mixture).
- Use the provided measure to fill foundation Ecobags with the sand/cement mixture.
- Place and compact one layer of the Ecobags in the foundation and water down thoroughly.
- Continue placing two to three more layers, until the bags are approximately 150 mm above the natural ground level.
- Make sure that the top layer is leveled as well as possible and that the Ecobags are in line with the foundation measurements.



4.5 Wall Panel Assembly

- Ensure that the Ecobeams remain in their pre-packed bundles to avoid confusion.
- Start assembling the various wall panels by laying them flat on the ground in their respective positions. Use 75 mm screws or nails to connect the beams to each other, making sure that the structure always remains square and at right angles.
- In the same way implement the Ecobeam lintels for doors and windows on the exact height into the wall panel. Fix them with an additional strip of flat lattice diagonal to both studs.

4.6 Erection of the Ecobeam Frame Structure

- Put the DPC in place.
- Erect the assembled panels in position according to the assembly plans and temporarily support in position by diagonal supporting timbers.
- Make sure the panels are perfectly leveled.
- Attach wall panels together using 75 mm screws or nails.
- Span metal wires from the studs next to windows and corners to their neighbors to prevent bowing of Ecobeam due to pressure of stacked sandbags (window: 1 in the middle, corners: min. 2).



4.7 Placing Ecobags in Framework

- Place sand as close as possible to the site of the new structure to minimise handling (ideally, place many smaller piles every few meters around the building).
- Use the measure scoop to fill all the wall Ecobags with sand. Take note that NO cement is added to the bags for the walls.
- Start by placing and compacting (tamping) the bags in the Ecobeam frame. Important: compact with the tamper after each layer of bags filled in.
- The bags can be packed in columns. Overlapping in the fashion of ordinary bricks is not necessary as the distance between the wall studs is short enough. Make sure after each layer of bags that you build it up absolutely straight and the wall is not bulging. A uniform, straight wall will also save plaster.



4.8 Installations

- Frames of doors and windows can be attached to the construction very early.
- Most electrics, plumbing and heating can be installed at this stage as well.
- They can be laid in the middle of the sandbag wall or can be fixed with metal wire to the Eco-beam structure or to the sandbags on the surface of the wall. Afterwards they are embedded in the first layer of plaster.



4.9 Wire Mesh

- The plinth in any case should be done with a moisture-resistant cement plaster. If you use a stronger mesh, it can help you shaping the form of the plinth.
- To cover the house with wire mesh is only necessary if you use cement plaster or slippery plastic sandbags. If you use hemp or geo-textile bags in combination with clay plaster you can skip this step and plaster directly on the bags.
- Nail the galvanized mesh to the entire frame, both internally and externally. Make sure that the mesh is pulled as tight as possible.
- Use galvanized metal wire to tie the mesh together through the walls (every 50cm, several times from bottom to top).



4.10 Plaster

- First choice should be to use clay plaster. You can also use a normal cement plaster if no clay is available or if there is no possibility for the clay to dry properly.
- To find the right ingredients and mixture for the clay plaster, it is best to ask local clay experts. As every climate has its own requirements for the plaster, different clay plaster traditions are available all over the world.
- Choose one section of wall (approx. 1,8 m wide) at a time and water down thoroughly.
- Plaster the section of wall with a first rough layer. Make sure that it has a rough finish for a better adhesion of the second layer.

- Continue the above with the rest of the structure, taking one section at a time.
 - Do the second layer of plaster with the same procedure as above but with a nice finish.
- Note: Skilled assistance during plastering the second layer will ensure a smooth finish.
- Alternatively, siding or cladding can be used instead of plaster to finish the wall.



4.11 Floor

- Fill up the rooms with gravel or dry clay up to the level shown in the plinth detail plan and compact it thoroughly. Don't forget a vertical DPC to separate the clay from the sandbag walls.
- Fill enough bags with the same sand cement mixture as per step 4.4
- Place layer of horizontal DPC.
- Place one layer of bags throughout the floor area, level and compact.
- Place wire mesh and attach it to the Ecobeam frame.
- Mix and place floor screed, use wire mesh for reinforcement.
- As an alternative to Ecobags and cement screed, an earthen screed or a timber floor on bearing woods is possible.

4.12 Roof

On Ecobag houses you can generally use any available kind of roof covering. Of course, first choice should be to find a natural material here as well.

The advantage of doing the roof very early is to protect the walls and the workers from rain and sun. But do not cover it before you have filled up the walls to at least one third of the height. Otherwise the structure is not strong enough to resist winds.



5. Sandy Future?

The sandbag technology is still in its beginning stages, but its future is very bright. In many countries it has the potential to revolutionize the construction market. Two major trends are preparing the ground. One is the increasing worldwide ambition to build in a more environmentally friendly way, and the second is the fact that the energy required to build sandbag houses is very low. In the future the sandbag system will become cheaper and cheaper as prices for energy and transport are rising all over the place.

5.1 Regional Differences

Of course it is not possible to find one type of house that is appropriate for every corner of the world. So the instructions given above are only an example for the standard Ecobag house as it is suitable for a lot of moderate climates around the world. It is the way most of the sandbag houses in South Africa were built.

For the purposes of sandbag projects, we have roughly divided the world in two main areas with different conditions.

- First are developing countries, like India, with cheap labor, a warm climate, and usually with much less difficulties with building permissions. In these countries, large-scale building with the Ecobag system could start immediately.
- Second are the developed countries, mainly Europe and US. Here you have very high labor costs, often the need for good thermal insulation, and stricter rules for building permissions. Before doing large-scale projects, research has to show if and how much extra insulation is needed. For insulating, the priority should be not to sacrifice the inherent low-cost simplicity of the sandbag system.

To keep labor costs to a minimum in these countries, 1) Ecobeams can be made in a factory and sent to the worksite as a kit, and 2) machines can be used for making the bags, filling them with sand, and applying plaster.

But within these areas it is always necessary to look at regional and local conditions. Beside the legal situation and the climate there are factors like stability of the soil or the local availability of materials. In some regions it might be cheaper to use solid wood instead of the Ecobeam. And in some mountain regions, sand is expensive due to long transportation.

5.2 Legal Situation

At the moment South Africa and a few surrounding countries are the only ones with a kind of sandbag tradition and a secure legal structure. Building is easy as everyone can refer to a general approval for Ecobag houses. In all other countries it is something new to the authorities. If you want to build with a new non-listed material, then in many countries you need to apply for a single case permission. You have to prove to the authorities that the Ecobeam system is in accordance with the building standards of their country. This can be tricky as the Ecobag wall has the form of a timber frame wall, but since the wall studs are not really bearing the vertical load, its behaviour is more of a monolithic wall. Of course it is possible to use lab tests that were done in other countries to reach a single case permission, as long as the tests are done in accordance with the testing standards in the country where you want to apply.

With a series of new lab testing in South Africa, Ecobeam Technology wants to establish a basis to change this situation. In Great Britain they are applying for a European Technical Approval (ETA). This will allow people all over the European Community to use the Ecobag System. Then sandbags will be a listed construction material in Europe, which makes it easier to get approvals also in other countries. But the process of getting this ETA is quite long, it usually takes one to one and a half years, so might not be ready until late 2009.



5.3 In Combination with other Materials

The Ecobag house is not a closed system; it is open for new ideas. In the future it will be mixed up with traditional, common and new construction types and materials. Two examples of combinations which have already been done successfully:

Sandbags can replace the brick filling of concrete frame buildings. Most houses in India, for example, are made with this technology. If sandbags replace the brick we not only have the advantages mentioned above, but it also makes the process of building easier: instead of first

pouring the concrete columns and then mason the bricks in between, we can first raise up the standard Ecobag wall leaving out the corners and places in the wall to pour in columns later. Afterwards the structure of the Ecobeam frame can be used for fixing the shutter boards at those parts where the concrete is not poured onto the sandbags directly.

With this technology the Ecobag system can be used for multi-level houses. Another advantage is that it will be much easier to get building permissions if the sandbags are not part of the load-bearing structure but only the filling of a framework.

Another possibility that has been done in South Africa is to combine sandbags with another upcoming ecological building system: straw bales. This makes a lot of sense in colder climates like middle and northern Europe. Straw bales by their nature are very good insulators and are cheaply available throughout Europe in large quantities. But for internal walls the bales need too much space, so a thinner sandbag wall of about 20 or 25 cm can be a perfect alternative. It even adds the features of high sound insulation and high thermal mass. By the way, it is not the slightest problem to knock in nails for fixing pictures to a sandbag wall. No sand will fall out.

5.4 Temporary Buildings

There is one main difference between common temporary structures (e.g. tents) and an Ecobag concept. The house made by sandbags has all the qualities of a normal solid house with all its huge mass, whereas tents or shacks are too hot, too cold, too noisy and so on.

Ecobag technology can be used for different kinds of temporary applications. The reasons are obvious: the construction rate is fast, no moisture needs to be dried out and the material is available everywhere and cheap. But there is another very important factor: what happens after the short period of utilization? One solution is to make an all-natural building with bags of jute that is decomposing when the building is without rain shelter after its use. Everything is renatured. This has been done successfully in South Africa by building a castle for the setting of a movie. Another solution is to reuse all the materials. If it is a dry construction without plaster, then everything can be taken down and stored for later use. Or it can be transported to another location and built up again.

There is another interesting opportunity: in refugee camps or after natural disasters tents out of Ecobeams can be built up within hours, to provide quick shelter. Then, step-by-step, the tent can turn to a solid durable house within the following months or years. From the inside, the Ecobeam framework is filled up with sandbags while the outer appearance is still a tent. Later the walls can be plastered and painted, first inside then outside and the tent roof can be replaced by an ordinary roof. Poor people can rebuild their houses mostly by themselves in an inexpensive and easy way and are not dependent on foreign development aid.

List of Works Consulted

-Ecobag Guide - Building a House with Sandbags

by Joachim Cleas and Stefan Kracht, Novokievka, Ukraine, 2007

-Draft Document for a Rational Design for the “Building by Bag” System

by Ecobeam Technologies, Cape Town, South Africa, 1st issue 1995, updated 2008

-Ecobeam Technologies

<http://www.ecobuildtechnologies.com>

-Wikipedia -sand-

<http://en.wikipedia.org/wiki/Sand>, June 2008

-The International Sand Collectors Society

http://www.sandcollectors.org/What_is_Sandx.html, June 2008

-Interessand / Sand-ABC

<http://interessand.de/copyright.htm>, June 2008

Presented by Dipl.-Geologe Dr. Dietmar Meier

-Various Interviews with Michael Tremeer, Ecobeam Technologies, 2007/08

Tests Referred to:

-Load Test for Ecobeams, Report No.: 4471/88157

South African Bureau of Standards, Cape Town, 13th Aug. 1996

-Structural and Rain Penetration Tests, Report No.: 812/87574

South African Bureau of Standards, Cape Town, 8th Mar. 1996